Digital technology use in dental practice

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Summary

The use of digital dental technologies influences oral health care, and the way in which oral health care is practiced influences the use of digital dental technologies. Dental practices, dentists, and experiences of patients with oral care influence whether and how digital technologies are used. In this thesis, technology use in dental practices is studied. It looks at technology use from a social perspective rather than a technical one. Technology use, then, is inseparable from political, economic, social, and cultural realms. This thesis looks at how technologies, users, and the context in which they are situated mutually shape each other and become mixed. The studies presented herein aim to investigate the impact of digital innovations on the practice of dentistry. They focus on three key research questions: (1) *Which promoting and constraining characteristics can be identified in dentists' adoption and rejection of digital developments?* (2) *Which changes impacting on the dental workforce can be expected to develop alongside the increasing role of digital techniques in the field of dentistry?* and (3) *How do dentists and dental practices adapt to these changes, and what are the consequences of these adjustments?*

First, an explorative qualitative study was conducted to fathom why some dentists adopt and use digital dental technologies more than others, and which incentives for and barriers against accepting and using digital dental technologies exist. This study, described in chapter 2, used semi-structured interviews with experts in dentistry, dental technology and dental education in the Netherlands. The analysis of the interviews showed that the main barriers and incentives to digital technology use were perceived advantages over analogue methods, perceived influence on treatment quality, dentists' personal and professional orientation, and social influence from peers and external groups. Characteristics of dentists and dental practices were also important in explaining use and non-use of digital dental technologies. The findings of this study suggested that large differences in motivations to adopt and use digital technologies and in attitudes to digitalization exist between dentists.

Chapter 3 describes the first of two chapters that looked into the adoption of digital technologies among a sample of general dental practitioners in the Netherlands. Using the study described in chapter 2, a questionnaire was developed which asked dentists about (1) their use of administrative and clinical digital technologies and (2) characteristics of themselves, and of the dental practice they worked in. In general, dentists used administrative technologies more than clinical technologies. Dentists had adopted an average number of 6.3±2.3 technologies. With few exceptions, dentists use some or a substantial number of digital technologies. On the basis of the number of digital technologies that dentists used, three groups of technology users were distinguished: low technology users (who used 0 to 4 technologies), intermediate technology users (who used 5 to 7 technologies) and high technology users (who used 8 to12 technologies). High technology users more frequently had a specialization, were younger on average, and worked more hours per week than low technology users. They also invested more hours per year in professional activities

than intermediate technology users did. High technology use was also more common for dentists who worked in larger practices: those which were visited by more patients per year on average, and where more dentists and more staff were working. With few exceptions, all dentists use some or a substantial number of digital technologies. The findings of this chapter gave an insight into the current state of digital technology adoption in dental practices, and characteristics of dentists and dental practices associated with it.

In chapter 4, dentists' opinions which are associated with level of technology use were investigated. This study used the same questionnaire as chapter 3, and the items on opinions about technology use were derived from the interviews described in chapter 2. The study also included measures of which aspects of their work were most motivating to dentists, in order to measure professional orientation (which was discussed in chapter 2). Principal components analysis and factor analysis were used to analyse the opinions of dentists on technology use and the motivating aspects of their work. The scores on scales derived from these analyses were then compared for low, intermediate, and high technology users. How dentists scored on opinions about digital technologies and on motivating work aspects, varied with their level of technology use (low, intermediate or high). In this study, a multiple linear regression analysis was then done to assess the association of dentists' scores on opinions about technology use with the number of technologies dentists used. In this analysis, motivating work aspects, as well as the characteristics of the dentist and dental practice described in chapter 3 were included in the model first, and then opinion scales were added. In this model, in addition to the factors just mentioned, being more focused on technologies and perceiving a higher added value from using technologies were associated with using more digital dental technologies.

Chapter 5 describes a study aimed to update information on the use of newer technologies among dentists and the factors that influenced their adoption. It was conducted in New Zealand, and used a survey. This chapter investigated a somewhat different ensemble of technologies than the preceding chapters, by focusing on newer, clinical technologies. This included but was not limited to digital technologies, and in this study administrative technologies were not investigated. This was done in order to be able to compare the data with an earlier study conducted in New Zealand in 2007. Of the 17 technologies investigated, digital intra-oral radiography, digital apex locators and rotary endodontic units were the most commonly used. Least commonly-used were digital impression units, digital colour determination and ozone units. Dentists in this study ranked improving quality of care and increasing efficiency as the two most important factors when deciding about using a newer technology. Dentists used an average of 4.9 ± 2.5 technologies. Whereas the study reported in chapter 3 found a number of associations between the characteristics of the dentist and the dental practice and the extent of technology use, in this study there were no significant differences apart from a significantly greater average number of technologies used by

men compared to women. Since the study conducted in New Zealand in 2007, the use of digital radiography and dental laser units has increased. On the contrary, the use of power bleaching units, caries diagnosis units and ozone units has decreased. The use of other technologies has remained similar. This study has provided some insight into the changing trends in use of dental technologies by dentists, which allows for a better understanding of what works for dentists, and of why some technologies are adopted and others are not.

Chapter 6 describes a study on what happens when dentists use digital technologies in dental practice. It moves beyond the focus on decision-making around using technologies used in the preceding chapters, by investigating dentists' accounts of implementation. It is based on a constructivist grounded theory. In this study, 24 dental practitioners in the Netherlands participated in in-depth semi-structured interviews. This study posits that when using digital technologies, dentists go through several phases. These phases are 'starting points', 'evaluating influences and making decisions', 'acting on disruptions and continuities' and 'seeing results and consequences'. In this study, two concepts were developed, which are present in these four phases: *expectations for dental practice* in the future, and the praxis around *fitting technologies into dental practicing*. Looking at the first concept, *expectations for dental practice*, shows that dentists' use of technologies is future-oriented: expectations about their profession and about technologies formed the base for how technology use is experienced, and which actions dentists take. *Fitting technologies into dental practice* often involved a large amount of work. This work takes place in aligning skills, the team working in a practice, and material and social contexts. Technology use was to some extent incorporated into dental professionalization, this study found. This incorporation of technology use in professionalization showed differences between older digital technologies, which were defined as a part of professional practice, and newer digital technologies, which were questioned and often kept at a distance. Core ideas about the dental profession were very important in how dentists adapted to technologies and to consequences of technology use. At the same time, using technologies rearranged parts of these core ideas of professionalism. Thus, this chapter described both the effects digital technology use had on dental practitioners, and the effects dental practitioners had on digital technology use in dental practices.

This thesis suggests that digital technology use is extensively present in dental practice. Technologies' attributes, dentists' characteristics, dental practices' characteristics, opinions and attitudes of dentists, and socio-political context all influence the extent and character of digital technology use by dentists. Furthermore, this thesis has shown that technology use has a substantial impact on developments in dental practicing. This impact needs to be understood and addressed when implementing technologies and when using digital technologies in dental practice.